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Final Global Harmonization Roadmap & Summary Report of Methodology

Submitted by:

Booz | Allen | Hamilton
8255 Greensboro Drive
McLean, VA 22102

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PURPOSE

This document presents an overview of the activities performed and the overall effort dedicated to the Global Harmonization (GH) Roadmap and Dashboard development, from 04/27/11 – 10/07/11, as part of Sub-Task 5 under Task Order 0025 - NextGen JPE Enterprise Architecture and Engineering Support.

SCOPE

A summary of the changes that have been made to the GH Database is included to present how the structure and content of the database have evolved as a result of the data refinement efforts performed during this phase. The Change Management (CM) Process, for adjudicating change requests related to GH elements, is also described at a high-level. Additionally, this document details the Gap Analysis methodology and presents the updated Roadmap of the GH activities currently included in the GH Database.

SUMMARY OF CHANGES

Since the beginning of the second phase of the GH Roadmap development effort, initiated on April 27, 2011, various structural and content changes were made to the GH sections within the Joint Planning Environment (JPE)[1]. The GH Activities Database has been augmented to include 312 harmonization activities. The database has been expanded through further research and identification of other relevant initiatives from the National Airspace System Enterprise Architecture (NAS EA) and the European Air Traffic Management (ATM) Master Plan. The Federal Aviation Administration (FAA)/ Single European Sky ATM Research (SESAR) Joint Undertaking (SJU) coordination plans[2] and International Civil Aviation Organization (ICAO) Aviation System Block Upgrades (ASBUs) were also incorporated. Additionally, activities from other global regions were reviewed and incorporated, as applicable.

The content within the GH Database has been modified to improve the accuracy and currency of the information through several data refinement efforts and the incorporation of adjudicated comments, accompanied by the initiation of the data validation effort. Various attributes and relationships were added within the GH activities structure to enable further grouping and categorization of activities, as well as establish linkages between GH activities and the Integrated Work Plan (IWP) and NAS EA Elements. The most significant incorporation was the ICAO Global Structure, which consists of ICAO Operational Concept Components (OCCs), Key Performance Areas (KPAs), Global Plan Initiatives (GPIs), and most importantly, ICAO ASBU Modules. All GH activities have been aligned to their applicable OCCs, KPAs, and GPIs, as well as their associated ASBU Modules to facilitate the comparison of data. To better categorize the existing data, activities were also aligned to relevant ICAO Panels, Radio Technical Commission for Aeronautics (RTCA) Special Committees, and European Organisation for Civil Aviation Equipment (EUROCAE) Working Group venues, as appropriate.

Furthermore, the GH Dashboard Section has been modified to include additional charts and graphs, representing metrics identified in the data contained in the GH Activities Database. These graphs allow users to quickly view the number of and listing of activities associated with each attribute. The following charts have been added to the Dashboard: SESAR/NextGen Collaboration Area Activity Count; Activities Related to Phase of Flight; Affected Domains;

[1] Refer to the "Document Enhancements to Dashboard and Decision Support Tools and Potential Metrics" document (CDRL#: 0012) for detailed descriptions of all modifications made to the *Harmonization Activities* Section and *Harmonization Dashboard* Section within JPE.

[2] The FAA/SJU Coordination Plans were established under Annex 1 of the Memorandum of Cooperation (MoC) between the European Union and the United States to focus on the near-term and in-service aspects of EU/U.S. ATM interoperability.

Venues; Capabilities; ICAO OCCs, KPAs, GPIs, and ASBUs. The augmented Dashboard is intended to provide a more thorough quantitative insight into the distribution of activities per selected attribute.

CHANGE MANAGEMENT METHODOLOGY

A Change Management (CM) Process was developed specifically for the GH Activities Database to provide the means to manage change requests pertaining to GH elements contained within the JPE[3]. The process is an established method for capturing, documenting, and implementing stakeholder input though configuration identification, status accounting, and verification and audit of GH data. Evaluating and incorporating stakeholder feedback, through this process, will further develop, mature, and refine the GH Activities Database.

Change Management Process

The CM Process defines the activities by which comments and/or proposed changes to the baseline GH information are submitted, evaluated, adjudicated and implemented in order to produce an updated baseline set of information. Since the inception of the CM Process, over 30 GH change requests have been adjudicated, and approved changes have been incorporated in JPE. The CM Process is depicted below in Figure 1, and the associated steps are described in further detail in Table 1. The applicable Change Request States are also listed for each step of the process.

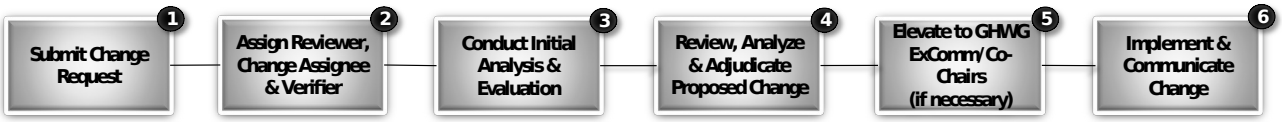


Figure 1 – Change Management Process Steps

Table 1 – Description of Change Management Process Steps

Process Steps	Explanation/Description of Process Steps
Step 1. Submit Change Request	– Requestor submits proposed change via Request Change Form in JPE o Change Requests can be made toward specific activity elements or the Global Harmonization Activities Database as a whole (changes that surround a general subject or recommendations for including new activities) – JPE system logs Requestor's change request o **Change Request State: Unassigned**
Step 2. Assign Reviewer, Change Assignee & Verifier	– JPE notifies the Task Lead that a new request has been added – The Task Lead assigns a Reviewer, a Change Assignee and a Verifier to the change request o Reviewer role: to conduct an initial analysis and evaluation of the proposed change o Change Assignee role: to make the associated modifications after adjudication o Verifier role: to verify that the Change Assignee implemented the changes correctly – JPE system notifies the Reviewer of assignment via e-mail o **Change Request State: Assigned**

[3] Refer to the "Global Harmonization Roadmap Governance Memorandum" document (CDRL#: 0008) for a detailed description of the Change Management (CM) Process.

Step 3. Conduct Initial Analysis & Evaluation	– Reviewer accesses Requestor's change request in JPE o Reviewers include SMEs, Working Group POCs, etc. – Reviewer evaluates the proposed change and decides: o Is there sufficient information? o Is this a valid change? o What is the scope of the change? o Are there dependencies that will be affected if the change is implemented? o What are the costs/benefits/risks of the change? – Reviewer recommends how the proposed change should be implemented and documents this in existing JPE Change Request Form o If there is not sufficient information, Reviewer solicits additional feedback and elaboration from Requestor (Change Request remains in "Assigned" state) – Reviewer marks the proposed change "Ready for Adjudication" o **Change Request State: Ready for Adjudication**
Step 4. Review, Analyze & Adjudicate Proposed Change	– Proposed change is reviewed and analyzed by FAA Project Lead, Task Lead, and Team Representatives (as applicable) – collectively called the GH Adjudication Board (GHAB)[4] o If there is not sufficient information to make a decision, the change request is sent back to Reviewer to gather additional feedback from Requestor o **Change Request State: Hold for More Analysis** – The GHAB makes an adjudication decision o Decisions include: Accept, Accept with Change, Decline, or No Action Required o **Change Request State: Adjudicated**
Step 5. Elevate to GHWG ExComm/GHWG Co-Chairs (if necessary)	– If the GHAB cannot reach concurrence on whether to incorporate the change request, a summary of the proposed change and recommendation goes to GHWG ExComm for approval – If GHWG ExComm concurs with the GHAB's adjudication decision, the change request is marked as "Approved" within JPE o **Change Request State: Approved** – If GHWG ExComm does not agree with the GHAB's adjudication decision, the change request is either rejected or sent back to Reviewer to perform additional analysis. o **Change Request State: Hold for More Analysis** – In the rare case that GHWG ExComm cannot reach consensus, or the issues are too significant in nature, the final approval decision goes to GHWG Co-Chairs who will make the decision with appropriate consultation of affected stakeholders.
Step 6. Implement & Communicate Change	– If the proposed change is Accepted or Accepted with Change, the Change Assignee implements the change and documents this in existing JPE Change Request Form – If the proposed change is Declined, and the GHWG ExComm concurs, the Change Assignee documents reasons for rejection in existing JPE Change Request Form o **Change Request State: Changed** – The Assigned Verifier confirms that the Change Assignee implemented the final resolution properly within JPE – Once confirmed, the Verifier closes the comment o **Change Request State: Closed** – The Requestor is notified that their comment has been closed.

Requestors can check the state of their change request within JPE at any time, and once the change request has been closed, they can view how their proposed change was implemented.

[4] Refer to Table 2 in the "Roles, Scope and Member of Adjudication Boards" section within this document to view the roles and responsibilities of GHAB, as well as the other two Adjudication Boards.

However, this effort will soon be automated to facilitate the tracking process of change requests for Requestors. JPE will automatically notify Requestors by e-mail every time their change request progresses from one state to another. The progression of change requests is described in further detail below:

1. Unassigned – Requestor has populated the designated fields and submitted Change Request Form
2. Assigned – Change request has been assigned to Reviewer; Reviewer performs analysis and documents recommended change request resolution
3. Ready for Adjudication – Review Team assesses the Reviewers recommended resolution and adjudicates the change request
4. Hold for More Analysis – If it is determined that sufficient information has not been provided by the Requestor, the Reviewer solicits additional feedback and elaboration from Requestor
5. Adjudicated – Adjudication decision has been reached and documented
6. Approved – The GHWG ExComm or GHWG Co-Chairs have approved the adjudicated decision
7. Changed – The Change Assignee has implemented the resolution based on the adjudication decision
8. Closed – The Verifier has confirmed that final resolution has been implemented properly in JPE.

Roles, Scope and Membership of Adjudication Boards

The Global Harmonization Adjudication Board (GHAB) is responsible for providing the initial review and analysis of all change requests received through the CM process. This board is authorized to provide an adjudication decision, where the proposed change has little to no impact on other configuration items. Proposed changes with greater impacts, such as cross-organizational changes that cannot be adjudicated by the GHAB, are elevated to the Global Harmonization Working Group Executive Committee (GHWG ExComm).

The GHWG ExComm serves as the upper-level board for changes that cannot be adjudicated by the GHAB. The GHWG ExComm also serves as the gateway to elevate issues to the highest level board, the GHWG Co-Chairs.

Table 2 below contains the various boards for adjudicating change requests along with their roles, scope, and membership.

Table 2 – Roles, Scope, and Membership of Adjudication Boards

Board	Role	Scope	Membership (as needed)	Criteria for Escalation
Global Harmonization Adjudication Board (GHAB)	Serves as lower-level board to review and respond to change requests. • Prioritizes Change Requests (CRs) • Schedules and convenes meetings • Approves Change Requests • Rejects Change Requests or places on hold and requests further information /	Changes that have little to no impact beyond the associated harmonization activity, or related to grammar/wording or description changes and those that do not have cross-organizational impacts.	• FAA Project Lead • Task Lead • Team Representatives (as applicable)	The change request has cross-organizational impact and cannot be resolved at the GHAB level. The GHAB cannot reach concurrence on whether to incorporate the change

	analysis			request.
Global Harmonization Working Group Executive Committee (GHWG ExComm)	Serves as upper-level board to address change requests elevated by the GHAB. • Approves Change Requests • Rejects Change Requests or places on hold and requests further information / analysis	Changes that have cross-organizational impacts, or change requests that cannot be resolved by the GHAB. Changes that require international coordination to address the change request.	Representatives from the following Organizations: • FAA • Aptis • L3 Communications • Mitre • DOC	The change request has cross-organizational impact and cannot be resolved at the GHWG ExComm level (i.e. if comment impacts an organization outside of FAA or JPDO).
GHWG Co-Chairs	Serves as the final level to address change requests elevated by the GHWG ExComm. • Approves Change Requests • Rejects Change Requests or places on hold and requests further information / analysis	Changes that cannot be resolved by the GHWG ExComm. Will make decision with appropriate consultation of affected stakeholders.	• GHWG Federal Co-chair • GHWG Industry Co-Chair • Affected Stakeholders (As necessary)	None

GAP ANALYSIS APPROACH AND METHODOLOGY

This Gap Analysis section summarizes the formal deliverable *Gap Analysis Document*[5]. In addition to summarizing the content of that document, this continues to provide additional information on the potential of a more detailed complementary Gap Analysis methodology that should be considered, once data consistency issues have been adequately addressed and resolved.

In order to identify misalignments between harmonization efforts, a Gap Analysis was performed on the activities data contained in the GH Database. Activities were aligned to each of the 46 ICAO ASBU Modules[6]. SESAR OI Steps were aligned through SESAR SJU, while the NextGen NAS EA OIs were respectively aligned, by the FAA, to the ICAO OCCs, KPAs, and GPIs. At the time of this report, the alignment of NAS EA OIs to ASBU Modules was still being developed by the FAA. As a result, NAS EA OI alignment to the Modules and any other stakeholder elements that were not already aligned to the ICAO Global Structure were aligned by relevant Subject Matter Experts (SME). As the FAA finalizes their (OI-ASBU Modules) alignments and/or should any relevant additional information become available, this analysis along with the documentation, tool sets, models, and methodologies will be available and applicable to update the results to reflect such alterations. This approach facilitates the

[5] Refer to the "Gap Analysis Document" (CDRL#: 0009) for further information on the Gap Analysis performed on the GH data, submitted September 21, 2011. Contract: DTFAWA-10-D-00030; Task Order: Task Order: 0025 - NextGen JPE Enterprise Architecture and Engineering Support; CDRL #: 0009; (30-0025-CDRL-0009-20110907).

[6] The *Global Air Navigation Industry Symposium (GANIS) Working Document: ICAO Aviation System Block Upgrades*, (issued on 12 August, 2011) was used as the primary reference source for aligning applicable activities. It contains the most recent detailed information for each ASBU Module.

identification of ASBU Modules that are missing key NextGen, SESAR and/or other stakeholder activities, and/or attributes based on the data contained in the GH Database.

The below steps were followed for the identification of missing activities and gaps:

Figure 2 – 5-Step Approach to Gap Analysis

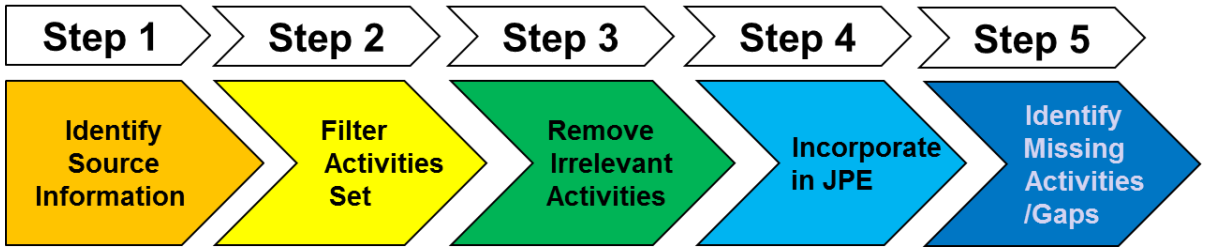


Table 3 – Description of Gap Analysis **Steps**

Process Steps	Explanation/Description of Process Steps
Step 1. Identify Source Information	– Identified ICAO Global Structure as the common attribute set and baseline for international aviation modernization activities o ASBU Modules Identified as appropriate and commonly understood objectives to perform Gap Analysis – Utilized existing alignments of SESAR Operational Improvement (OI) Steps to OCCs, KPAs, GPIs, and ASBU Modules – Utilized existing alignments of NAS EA OIs to OCCs, KPAs, and GPIs – Identified activities with no existing alignment and made subjective alignments for "best fit".
Step 2. Filter Activities	– Generated lists of applicable activities for each Thread[7] of Modules through filtering logic (described in the Methodology Section).
Step 3. Remove Irrelevant Activities	– Normalized data to help ensure consistency in the alignments – Recognized the data validation of the activities has not been completed.
Step 4. Incorporate in JPE	– Alignments were made in JPE

[7] "Thread" refers to the sequential progression of related Modules from Block 0 – Block 3 (i.e., B0-15, B1-15, B2-15, B3-15).

Step 5. Identify Missing Activities/Gaps	– Identified the presence (or lack thereof), of activity data elements associated with each Module based on alignments (described in the Results Section). – Identified Gaps in ICAO Global Structure attributes per the ASBU Modules as areas to further research and identify: o Attribute Misalignment o Capability Gap

Alignment of Activities to ICAO ASBU Modules Explained

The first two steps of the Gap Analysis included aligning any GH activity not already aligned to its applicable ASBU Module. In order to ensure consistency in the approach used for the alignments, a custom spreadsheet was created that listed all activities and their alignments to ICAO OCCs, KPAs, and GPIs. This spreadsheet contained a built-in functionality that allowed users to extract a listing of activities by using both "AND" and "OR" filtering logic functions. The "AND" filtering logic allowed users to view everything associated with *both* Attribute1 and Attribute2 – in other words, only activities that are aligned to *both* Attribute1 and Attribute2 were included in the generated list. The "OR" filtering logic allowed users to view everything associated with *either* Attribute1 or Attribute2 – in other words, all the activities that are aligned to *either* Attribute1 or Attribute2 were included in the generated list. Users filtered by a combination of ICAO Global Structure attributes (OCCs, KPAs, GPIs) and any relevant key search words, using a combination of the two filtering logics in their search.

This built-in functionality was developed to mitigate the prevalent inconsistency of the ICAO Global Structure attribute alignments to the activities and to the ASBU Modules. Mainly, this served to prevent the omission of potentially applicable activities in the generated lists that could have been caused by the inconsistency in the alignments. Additionally, this functionality allowed users the flexibility in their filtering options to ensure the optimum set of activities was generated for each Thread of Modules. Furthermore, it enabled users to search by an array of key words they thought were most applicable to each Module Thread, in addition to ICAO attributes.

In step three, the lists of potentially applicable GH activities were generated for each Module Thread. Activities were then examined one-by-one to determine which specific Module they pertained to, while activities that did not belong to any of the Modules in the Thread were discounted or removed. After the alignments were complete, each Module and its applicable set of aligned activities were then reviewed to identify areas where there were missing activities by key global stakeholders.

Next in step four, the ASBU Module alignments were uploaded to the JPE GH database.

The final (step five) analysis was then ready to be considered. Due to the maturity, consistency and validity of the data, a more rudimentary Gap analysis was delivered at this time. However, a more detailed/in-depth analysis methodology was also developed, should the data issues be resolved. Existing data consistency and maturity issues did not warrant a sub-Module level analysis. It was envisioned that as data matures and the attributes are validated for logic and consistency through the codification of rules for alignments, a data definition/dictionary and alignment map, a more granular review of ICAO attribute gaps could be feasible. The tool sets, models and methodologies, which are described herein, are available and would take little effort to update/upgrade.

Results and Challenges

With greater confidence in the activity data and ICAO attribute alignments, an analysis like the one depicted in Appendix B could be generated to depict the Gaps as described by the ICAO Global Structure attributes (OCCs, KPAs, GPIs). Cells highlighted in RED indicate there are no associated NextGen nor SESAR activities aligned to that particular attribute (that the ASBU

Module is aligned to). Cells highlighted in YELLOW indicate there are either no associated NextGen activities aligned to that particular attribute or no associated SESAR activities (i.e. only one of the two entities have activities that are mapped to the same attribute as the particular ASBU Module). Cells with no shading indicate that either the ASBU Module does not contain that attribute alignment or there are activities aligned to that Module that are also aligned to that attribute. For example, if an ASBU Module is appropriately aligned to GPI-21 and there are no Activities (which have been validated) that are aligned to GPI-21, then there would be at a minimum an Alignment Gap and possibly a more serious Capability Gap. An *Alignment Gap* is one in which the attributes and/or descriptive properties are either not consistent or not harmonized. A *Capability Gap* is one in which the intent of a proposed planning activity(ies) is significantly different which may prevent or threaten interoperability of the system(s), technology(ies), procedure(s) or policy(ies).

Below are the challenges that were encountered that could be addressed in future revisions and analyses to improve the overall identification, validity, logic, and veracity of the information presented. These challenges were identified as the following:

- Inconsistency in data alignments between ICAO ASBU Modules, NAS EA OIs, and SESAR OI Steps proved to be challenging when comparing activities
- Filtering criteria were based on subjective assessments with the best information available which led to challenges normalizing activity alignments. In some cases, the description of the activity was not detailed enough to make a high-confidence level assessment in the alignment
- Although ICAO recommends specific courses of actions through individual Modules, nation states may not necessarily fully implement the recommendations as documented, or do so in a timely fashion.

The Gap Analysis identified disparities in alignments of JPE GH activities to ASBU Modules among the international partners. Additionally, the analysis identified areas where data, for supporting activities, is expected to exist, but currently does not, based on the activities contained in the GH Database. Using the ICAO Block Upgrade approach as the framework for comparison allowed for a common baseline. The granularity of the analysis, however, was dependent on the data contained in JPE.

Once the maturity and validity of the GH data improves, the database architecture, and its associated functionality, is envisioned to serve as a decision support tool to guide efforts in the identification and resolution of capability and schedule gaps and misalignments in the harmonization process.

Next Steps Forward

Going forward, the following recommendations will assist in the improvement of the confidence level of the data elements and their associated alignments:

- Data Dictionary – A common data dictionary (or translation between terms) to achieve more uniform rules for alignments and taxonomy would assist with identifying new activities and help to better place existing activities within the architecture of JPE. A common challenge faced while doing this analysis was the inconsistency in alignments both within each of the stakeholder organizations and between the data alignments provided by the various stakeholder partners. By creating an agreed upon data dictionary, the database and analysis would be more accurate, reliable, and valuable in identifying gaps.
- ASBU/NextGen Alignments – Incorporate alignments of NAS EA Operational Improvements to ASBU Modules once completed and provided by the FAA.
- Alignment Map – A generally agreed upon framework for key search terms for block modules. This will help identify divergences in perspective between stakeholders

groups. By creating an Alignment Map, a greater understanding of multiple stakeholder modernization efforts/perspectives can be realized.

- Validation
  - Stakeholder – By helping guide stakeholders through the validation process, data alignment consistency in both the comment and adjudication portions of the configuration management process will be improved.
  - Logic – By applying common contextually-consistent and logical rules to alignment relationships, definitions and proposed stakeholder comments, consistency could be achieved and maintained to significantly enhance data utility.

Another consideration, going forward, is to distinguish between the various types of alignment relationships beyond the current singular "aligned" status. Activities may be *complementary* versus *dependent* activities necessary to achieve the objectives of an ASBU. Impacts have been delineated by some ICAO working groups as *primary* and *secondary*. Capturing additional relationship types increases complexity. However, it equally increases the potential for improving accuracy and achieving a greater depth of data. As the data becomes more mature, reliable and consistent, the Gap Analysis approach described in this document will yield further insight into the set of activities that are being undertaken from a global perspective toward harmonization and interoperability.

GLOBAL HARMONIZATION ROADMAP

The updated listing of activities in the GH Database, as a result of several data refinement efforts initiated during this phase of GH Roadmap development effort, serves as the basis for the GH Roadmap. The GH Roadmap provides a graphical representation of the identified harmonization activities based on each activity's assigned planned completion date. To focus on those activities with the most immediate importance to NextGen, activities from now through the mid-term (2018) are highlighted in the GH Roadmap. For completeness, the GH Roadmap also includes those activities that should have been completed prior to 2010 and those that are planned for the far-term (2018+). In the Roadmap, activities are grouped by Functional Area and are presented chronologically on the timescale. Through the interactive filters within JPE, a user can generate a customized view of the GH Roadmap by filtering by Functional Area, Harmonization Area, and/or Organization.

The GH Roadmap depicted in Figure 3 below shows various CNS-related activities for the Technology Functional Area on a timeline from Pre-2010 to 2018+. This customized Roadmap was generated by filtering by the Technology Functional Area; the Communication, Navigation, Surveillance Harmonization Area; and by NextGen, SESAR, ICAO, EUROCAE, Japan, India, Brazil, and China Organizations[8]. Refer to Appendix A for the complete listing of GH activities grouped by the seven Functional Areas.

[8] Refer to the *Administrators Guide* in the Global Harmonization section within JPE to view the step-by-step process on generating a customized Roadmap.

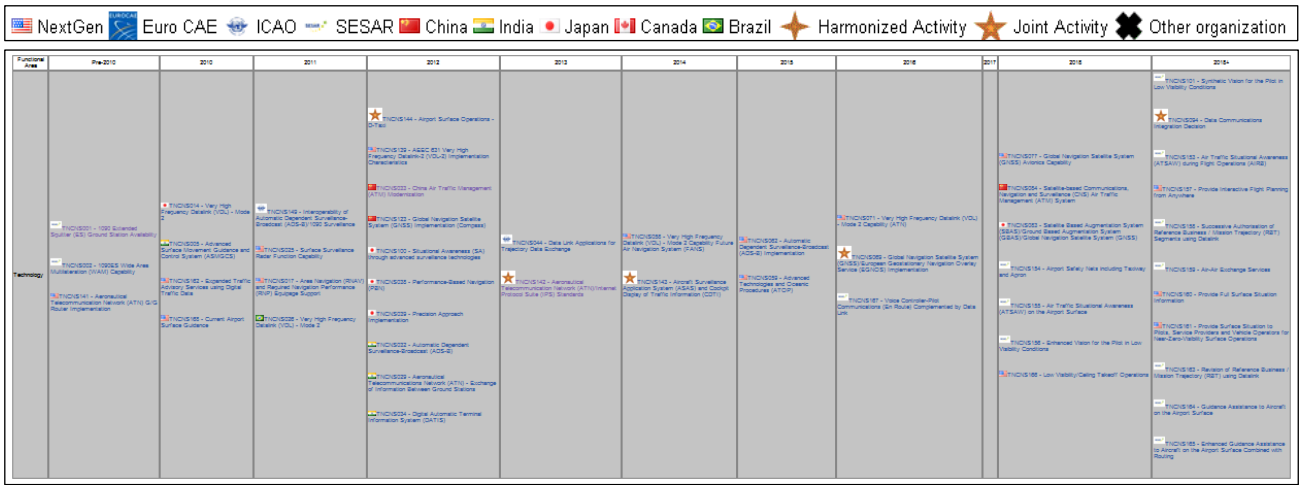


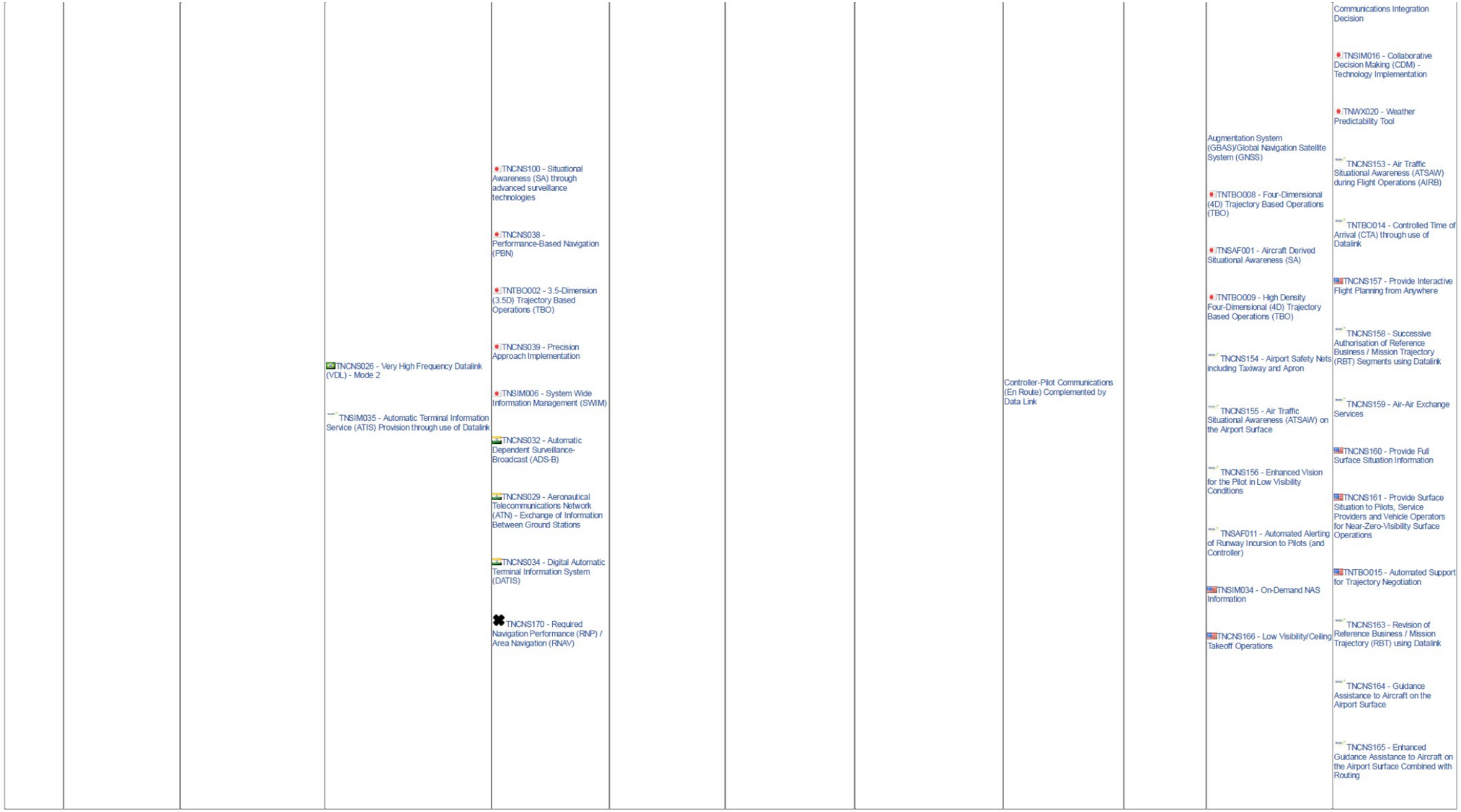
Figure 3 – Example Global Harmonization Roadmap for Technology Functional Area

APPENDIX A: Global Harmonization Roadmap (Full Version)

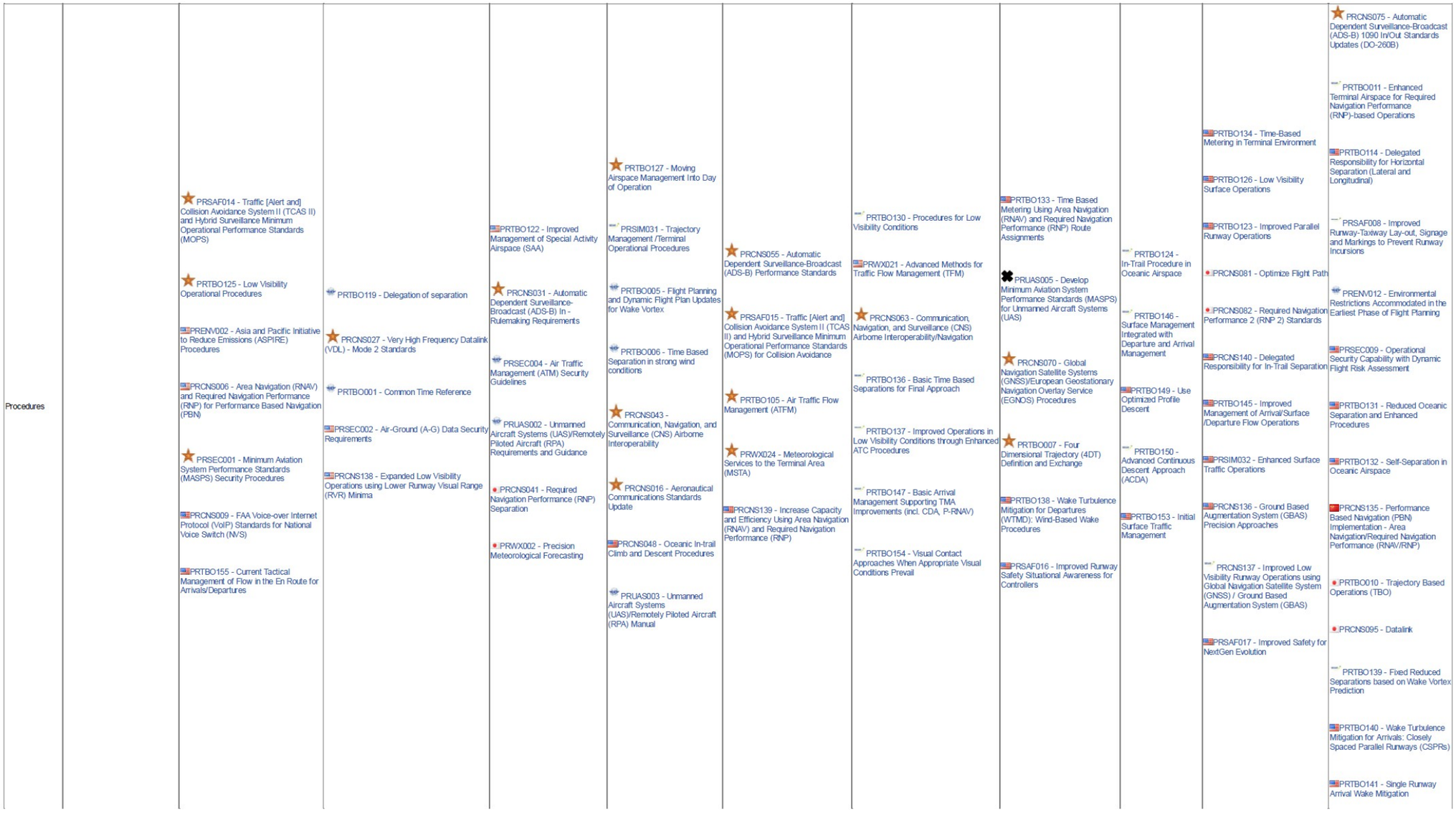
NextGen Euro CAE ICAO SESAR China India Japan Canada Brazil Harmonized Activity Joint Activity Other organization

Functional Area	Pre-2010	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018+
Information Management	MCNS004 - Air Traffic Services Message Handling System (AMHS) Implementation	IMTBO002 - Current Flight Plan Support IMWX031 - Current Terminal Advisory - Weather IMTBO004 - Current NAS Status Advisory	IMSIM023 - Information Management Framework IMCNS102 - Aeronautical Information Exchange Model (AIXM) IMWX029 - Meteorological (MET) Support to Air Traffic Management (ATM) for Performance-Based Navigation (PBN)	IMSIM021 - Aeronautical Information and Meteorological (MET) Datalink Services IMSIM005 - Information Sharing Protocols IMTBO003 - Integrated Pre-Flight Briefing	IMWX028 - Network Enabled Weather (NEW) Segment 1 IMCNS118 - Airport and Terrain Database Standards for Enhanced Low-Altitude Operations	IMWX009 - World Area Forecast System (WAFS) IMSAF001 - Enhanced Safety Information Analysis and Sharing	IMSIM022 - Flight Data Services IMWX011 - Aeronautical Communications Information Management/Meteorological (MET) Information Exchange	IMCNS068 - Facilitated Aeronautical Data Exchanges through Digitalised Information		IMSIM024 - International Information Sharing and Decision-Making	IMSIM010 - System Wide Information Management (SWIM) - Ground-Ground Extended Services IMCNS089 - Extended Operational Terminal Information Service Provision Using Datalink IMWX019 - Aircraft Dissemination of Information on Weather Hazards to Other Aircraft IMTBO001 - Single Runway Departure Wake Mitigation IMWX030 - Full Improved Weather Information and Dissemination IMCNS119 - Enhanced Ground-based Safety Nets Using Wide Information Sharing IMSIM025 - System Wide Information Management (SWIM) - Air-Ground Limited Services IMSIM026 - System Wide Information Management (SWIM) - Air-Ground Extended Services
Technology	TNCNS001 - 1090 Extended Squitter (ES) Ground Station Availability TNCNS002 - 1090ES Wide Area Multilateration (WAM) Capability TNCNS141 - Aeronautical Telecommunication Network (ATN) G/G Router Implementation	TNCNS014 - Very High Frequency Datalink (VDL) - Mode 2 TNCNS005 - Advanced Surface Movement Guidance and Control System (ASMGCS) TNCNS162 - Expanded Traffic Advisory Services using Digital Traffic Data TNCNS168 - Current Airport Surface Guidance	TNCNS149 - Interoperability of Automatic Dependent Surveillance-Broadcast (ADS-B)/1090 Surveillance TNTBO010 - Oceanic Tailored Arrival (TA) Automation TNSIM003 - FAA/SESAR Joint Undertaking (SJU) System Wide Information Management (SWIM) Interoperability TNCNS025 - Surface Surveillance Radar Function Capability TNCNS017 - Area Navigation (RNAV) and Required Navigation Performance (RNP) Equipage Support	TNCNS144 - Airport Surface Operations - D-Taxi TNCNS139 - AEEC 631 Very High Frequency Datalink-2 (VDL-2) Implementation Characteristics TNSAF010 - Guidance for Cockpit Display of Traffic Information (CDTI) Display and Alerting Standards TNCNS033 - China Air Traffic Management (ATM) Modernization TNCNS123 - Global Navigation Satellite System (GNSS) Implementation (Compass)	TNCNS044 - Data Link Applications for Trajectory Data Exchange TNCNS142 - Aeronautical Telecommunication Network (ATN)/Internet Protocol Suite (IPS) Standards TNTBO013 - Trajectory Management/Terminal Operations TNSIM036 - Automated Assistance to Controller for Seamless Coordination, Transfer and Dialogue	TNCNS058 - Very High Frequency Datalink (VDL) - Mode 2 Capability Future Air Navigation System (FANS) TNWX007 - World Area Forecast System (WAFS) TNWX004 - Aviation Meteorological (MET) Capability TNCNS143 - Aircraft Surveillance Application System (ASAS) and Cockpit Display of Traffic Information (CDTI)	TNCNS062 - Automatic Dependent Surveillance-Broadcast (ADS-B) Implementation TNWX013 - NextGen Weather Processor Interoperability with Canadian Radar TNSEC006 - Security Integrated Tool Set (SITS) Deployment TNCNS059 - Advanced Technologies and Oceanic Procedures (ATOP)	TNCNS071 - Very High Frequency Datalink (VDL) - Mode 2 Capability (ATN) TNSIM033 - System Wide Information Management (SWIM) - Ground-Ground Capability TNSAF007 - Improve Runway Safety Situational Awareness for Pilots TNCNS069 - Global Navigation Satellite System (GNSS)/European Geostationary Navigation Overlay Service (EGNOS) Implementation TNCNS167 - Voice		TNSIM009 - System Wide Information Management (SWIM) - European Ground Communication Infrastructure TNCNS077 - Global Navigation Satellite System (GNSS) Avionics Capability TNCNS084 - Satellite-based Communications, Navigation and Surveillance (CNS) Air Traffic Management (ATM) System TNWX016 - Improved Weather Forecast Information TNCNS083 - Satellite Based Augmentation System (SBAS)/Ground Based	TNSIM013 - System Wide Information Management (SWIM) - European Air-Ground Communication Infrastructure TNSIM008 - System Wide Information Management (SWIM) - Common Information Model TNCNS101 - Synthetic Vision for the Pilot in Low Visibility Conditions TNTBO011 - Reduced Oceanic Separation and Enhanced Procedures TNCNS094 - Data

Functional Area	Pre-2010	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018+


TNCNS026 - Very High Frequency Datalink (VDL) - Mode 2
TNSIM035 - Automatic Terminal Information Service (ATIS) Provision through use of Datalink
TNCNS100 - Situational Awareness (SA) through advanced surveillance technologies
TNCNS038 - Performance-Based Navigation (PBN)
TNTBO002 - 3.5-Dimension (3.5D) Trajectory Based Operations (TBO)
TNCNS039 - Precision Approach Implementation
TNSIM006 - System Wide Information Management (SWIM)
TNCNS032 - Automatic Dependent Surveillance-Broadcast (ADS-B)
TNCNS029 - Aeronautical Telecommunications Network (ATN) - Exchange of Information Between Ground Stations
TNCNS034 - Digital Automatic Terminal Information System (DATIS)
TNCNS170 - Required Navigation Performance (RNP) / Area Navigation (RNAV)
Controller-Pilot Communications (En Route) Complemented by Data Link
Communications Integration Decision
TNSIM016 - Collaborative Decision Making (CDM) - Technology Implementation
TNWX020 - Weather Predictability Tool
Augmentation System (GBAS)/Global Navigation Satellite System (GNSS)
TNCNS153 - Air Traffic Situational Awareness (ATSAW) during Flight Operations (AIRB)
TNTBO008 - Four-Dimensional (4D) Trajectory Based Operations (TBO)
TNTBO014 - Controlled Time of Arrival (CTA) through use of Datalink
TNSAF001 - Aircraft Derived Situational Awareness (SA)
TNCNS157 - Provide Interactive Flight Planning from Anywhere
TNTBO009 - High Density Four-Dimensional (4D) Trajectory Based Operations (TBO)
TNCNS158 - Successive Authorisation of Reference Business / Mission Trajectory (RBT) Segments using Datalink
TNCNS154 - Airport Safety Nets including Taxiway and Apron
TNCNS155 - Air Traffic Situational Awareness (ATSAW) on the Airport Surface
TNCNS159 - Air-Air Exchange Services
TNCNS160 - Provide Full Surface Situation Information
TNCNS156 - Enhanced Vision for the Pilot in Low Visibility Conditions
TNCNS161 - Provide Surface Situation to Pilots, Service Providers and Vehicle Operators for Near-Zero-Visibility Surface Operations
TNSAF011 - Automated Alerting of Runway Incursion to Pilots (and Controller)
TNTBO015 - Automated Support for Trajectory Negotiation
TNSIM034 - On-Demand NAS Information
TNCNS163 - Revision of Reference Business / Mission Trajectory (RBT) using Datalink
TNCNS166 - Low Visibility/Ceiling Takeoff Operations
TNCNS164 - Guidance Assistance to Aircraft on the Airport Surface
TNCNS165 - Enhanced Guidance Assistance to Aircraft on the Airport Surface Combined with Routing

Functional Area	Pre-2010	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018+


Procedures
PRSAF014 - Traffic [Alert and] Collision Avoidance System II (TCAS II) and Hybrid Surveillance Minimum Operational Performance Standards (MOPS)
PRTBO125 - Low Visibility Operational Procedures
PRENV002 - Asia and Pacific Initiative to Reduce Emissions (ASPIRE) Procedures
PRCNS006 - Area Navigation (RNAV) and Required Navigation Performance (RNP) for Performance Based Navigation (PBN)
PRSEC001 - Minimum Aviation System Performance Standards (MASPS) Security Procedures
PRCNS009 - FAA Voice-over Internet Protocol (VoIP) Standards for National Voice Switch (NVS)
PRTBO155 - Current Tactical Management of Flow in the En Route for Arrivals/Departures
PRTBO119 - Delegation of separation
PRCNS027 - Very High Frequency Datalink (VDL) - Mode 2 Standards
PRTBO001 - Common Time Reference
PRSEC002 - Air-Ground (A-G) Data Security Requirements
PRCNS138 - Expanded Low Visibility Operations using Lower Runway Visual Range (RVR) Minima
PRTBO122 - Improved Management of Special Activity Airspace (SAA)
PRCNS031 - Automatic Dependent Surveillance-Broadcast (ADS-B) In - Rulemaking Requirements
PRSEC004 - Air Traffic Management (ATM) Security Guidelines
PRUAS002 - Unmanned Aircraft Systems (UAS)/Remotely Piloted Aircraft (RPA) Requirements and Guidance
PRCNS041 - Required Navigation Performance (RNP) Separation
PRWX002 - Precision Meteorological Forecasting
PRTBO127 - Moving Airspace Management Into Day of Operation
PRSIM031 - Trajectory Management /Terminal Operational Procedures
PRTBO005 - Flight Planning and Dynamic Flight Plan Updates for Wake Vortex
PRTBO006 - Time Based Separation in strong wind conditions
PRCNS043 - Communication, Navigation, and Surveillance (CNS) Airborne Interoperability
PRCNS016 - Aeronautical Communications Standards Update
PRCNS048 - Oceanic In-trail Climb and Descent Procedures
PRUAS003 - Unmanned Aircraft Systems (UAS)/Remotely Piloted Aircraft (RPA) Manual
PRCNS055 - Automatic Dependent Surveillance-Broadcast (ADS-B) Performance Standards
PRSAF015 - Traffic [Alert and] Collision Avoidance System II (TCAS II) and Hybrid Surveillance Minimum Operational Performance Standards (MOPS) for Collision Avoidance
PRTBO105 - Air Traffic Flow Management (ATFM)
PRWX024 - Meteorological Services to the Terminal Area (MSTA)
PRCNS139 - Increase Capacity and Efficiency Using Area Navigation (RNAV) and Required Navigation Performance (RNP)
PRTBO130 - Procedures for Low Visibility Conditions
PRWX021 - Advanced Methods for Traffic Flow Management (TFM)
PRCNS063 - Communication, Navigation, and Surveillance (CNS) Airborne Interoperability/Navigation
PRTBO136 - Basic Time Based Separations for Final Approach
PRTBO137 - Improved Operations in Low Visibility Conditions through Enhanced ATC Procedures
PRTBO147 - Basic Arrival Management Supporting TMA Improvements (incl. CDA, P-RNAV)
PRTBO154 - Visual Contact Approaches When Appropriate Visual Conditions Prevail
PRTBO133 - Time Based Metering Using Area Navigation (RNAV) and Required Navigation Performance (RNP) Route Assignments
PRUAS005 - Develop Minimum Aviation System Performance Standards (MASPS) for Unmanned Aircraft Systems (UAS)
PRCNS070 - Global Navigation Satellite Systems (GNSS)/European Geostationary Navigation Overlay Service (EGNOS) Procedures
PRTBO007 - Four Dimensional Trajectory (4DT) Definition and Exchange
PRTBO138 - Wake Turbulence Mitigation for Departures (WTMD): Wind-Based Wake Procedures
PRSAF016 - Improved Runway Safety Situational Awareness for Controllers
PRTBO124 - In-Trail Procedure in Oceanic Airspace
PRTBO146 - Surface Management Integrated with Departure and Arrival Management
PRTBO149 - Use Optimized Profile Descent
PRTBO150 - Advanced Continuous Descent Approach (ACDA)
PRTBO153 - Initial Surface Traffic Management
PRTBO134 - Time-Based Metering in Terminal Environment
PRTBO126 - Low Visibility Surface Operations
PRTBO123 - Improved Parallel Runway Operations
PRCNS081 - Optimize Flight Path
PRCNS082 - Required Navigation Performance 2 (RNP 2) Standards
PRCNS140 - Delegated Responsibility for In-Trail Separation
PRTBO145 - Improved Management of Arrival/Surface /Departure Flow Operations
PRSIM032 - Enhanced Surface Traffic Operations
PRCNS136 - Ground Based Augmentation System (GBAS) Precision Approaches
PRCNS137 - Improved Low Visibility Runway Operations using Global Navigation Satellite System (GNSS) / Ground Based Augmentation System (GBAS)
PRSAF017 - Improved Safety for NextGen Evolution
PRCNS075 - Automatic Dependent Surveillance-Broadcast (ADS-B) 1090 In/Out Standards Updates (DO-260B)
PRTBO011 - Enhanced Terminal Airspace for Required Navigation Performance (RNP)-based Operations
PRTBO114 - Delegated Responsibility for Horizontal Separation (Lateral and Longitudinal)
PRSAF008 - Improved Runway-Taxiway Lay-out, Signage and Markings to Prevent Runway Incursions
PRENV012 - Environmental Restrictions Accommodated in the Earliest Phase of Flight Planning
PRSEC009 - Operational Security Capability with Dynamic Flight Risk Assessment
PRTBO131 - Reduced Oceanic Separation and Enhanced Procedures
PRTBO132 - Self-Separation in Oceanic Airspace
PRCNS135 - Performance Based Navigation (PBN) Implementation - Area Navigation/Required Navigation Performance (RNAV/RNP)
PRTBO010 - Trajectory Based Operations (TBO)
PRCNS095 - Datalink
PRTBO139 - Fixed Reduced Separations based on Wake Vortex Prediction
PRTBO140 - Wake Turbulence Mitigation for Arrivals: Closely Spaced Parallel Runways (CSPRs)
PRTBO141 - Single Runway Arrival Wake Mitigation

Functional Area	Pre-2010	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018+

											PRTBO142 - Self-Separation Airspace Operations PRTBO143 - Reduce Separation - High Density Terminal Less Than 3-miles PRTBO144 - Optimised Route Network using Advanced Required Navigation Performance (RNP1) PRTBO148 - Integrated Arrival/Departure Airspace Management PRTBO151 - Trajectory-Based Management - Gate-To-Gate PRTBO152 - Enhanced Departure Flow Operations
Policy		POCNS007 - Automatic Dependent Surveillance-Broadcast (ADS-B) Policy in Non-Radar Airspace POSAF014 - Traffic [Alert and] Collision Avoidance System II (TCAS II) and Hybrid Surveillance Minimum Operational Performance Standards (MOPS) Collision Avoidance Guidance POCNS119 - Surveillance - Global Harmonization POSEC001 - Global Security	POCNS015 - 1090 Surveillance/Automatic Dependent Surveillance-Broadcast (ADS-B) Integration Policy POCNS137 - Air-Ground (A-G) Communications Policy Decision POENV005 - Environmental Management System (EMS) Framework POENV006 - Environmental Standards - Global Harmonization POSEC003 - Data Comm Security Architecture	POWX003 - Weather Information Policy - Global Harmonization POUAS001 - Small Unmanned Aircraft System (UAS) Aviation Rulemaking POSEC012 - Defense System Standards - Global Harmonization POSAF003 - Role of Automated System Processing POCNS001 - Frequency/Spectrum - Global Harmonization	POCNS050 - Position, Navigation and Timing (PNT) Services - Global Harmonization	POWX010 - World Area Forecast System (WAFS) Program Plan POWX006 - Volcanic Ash (VA) Policy (International Airways Volcano Watch Operations Study Group (IAVWOPSG)) POSAF005 - Impact Assessment for NextGen Implementation both within the United States and Internationally POTBO001 - Airspace Regulatory Changes - Global Harmonization	POSIM012 - System Wide Information Management (SWIM) Policy for distributing weather information to aircraft POWX012 - Meteorological Information Exchange Policy for aircraft access to System Wide Information Management (SWIM) POCNS061 - Automatic Dependent Surveillance-Broadcast (ADS-B) Equipage Strategy	POSAF001 - Aviation Safety - Global Harmonization		POSIM034 - System Wide Information Management (SWIM) Governance and Supervision POSAF009 - Automation and Surveillance Roles	POCNS093 - Automatic Dependent Surveillance-Broadcast (ADS-B) Link (CTE-S3) POSAF013 - Guidance for Safety Practices POSAF011 - ICAO Global Aviation Safety Roadmap and Implementation Plan (GASR/GASP) POSAF012 - Improved Safety Across the Air Transportation System [and Intermodal] Boundaries
Performance Measurements			PMCNS021 - Data Communications System Performance Analysis		PMENV008 - Atlantic Interoperability Initiative to Reduce Emissions (AIRE) Flight Trials Data			PMENV009 - Metrics for Aviation Related Fuel Use and Emissions		PMCNS076 - Data Comm Performance Data PMTBO001 - Point-in-Space Metering PMTBO003 - Continuous Flight Day Evaluation	PMSIM015 - System Wide Information Management (SWIM) PMCNS131 - Performance Monitoring Air-to-Air Surveillance PMTBO002 - Multiple Controlled times of Over-fly (CTOs) through use of Data Link

Functional Area	Pre-2010	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018+

Demonstration	DESIM001 - System-Wide Information Management (SWIM)/Supported by Innovative Technology (SUIT) - Demonstration	DEENV003 - Atlantic Interoperability Initiative to Reduce Emissions (AIRE) - Demonstration DEENV001 - Asia and Pacific Initiative to Reduce Emissions (ASPIRE) Expansion	DECNS018 - Automatic Dependent Surveillance-Broadcast (ADS-B) In-Trail Procedures (ITP) and Automatic Dependent Surveillance-Contract (ADS-C) Climb/Descend Procedure (CDP) Trials - Demonstration			DETBO001 - Closely Spaced Parallel Runway Operations - Demonstration	DEUAS004 - Unmanned Aircraft Systems (UAS)/Remotely Piloted Aircraft (RPA) Four Dimensional Trajectory (4DT) Demonstration DETBO002 - Oceanic Tactical Trajectory Management (OTTM) - Demonstration				DEWX017 - Weather Avoidance Demonstration
Collaboration			COTBO002 - Aviation Cooperative Programs with China COSIM001 - Brazil Aviation Cooperation Program (ACP) COTBO001 - Aviation Cooperative Program with India COSAF003 - Airborne Collision Avoidance System (ACAS) Coordination Plan COTBO003 - Airborne Separation Assistance Systems (ASAS) Coordination Plan COCNS059 - Future Communication Technologies Coordination Plan COCNS060 - Automatic Dependant Surveillance- Broadcast (ADS-B) Coordination Plan COUAS001 - Unmanned Aircraft Systems (UAS) integration into ATM Coordination Plan COCNS061 - Flexible Communication Architecture Coordination Plan COCNS062 - Future Datalink Services Coordination Plan COTBO004 - Traffic Management (including trajectory integration and prediction) Coordination Plan COTBO005 - Flight Planning and Dynamic Flight Plan Updates Coordination Plan	COSAF001 - Establish Safety Management International Collaboration Group (SM ICG)	COSAF004 - Collaborative Delivery and Harmonization of CANSO Safety Initiatives COSIM004 - Harmonised Aeronautical Information through Common Data Model	COCNS057 - Brazil Technical Assistance Western Hemisphere - Interoperability	COWX003 - Interoperability of Canadian Traffic Flow Management (TFM) Systems with NextGen				COSAF002 - Increased International Cooperation for Aviation Safety

NextGen Euro CAE ICAO SESAR China India Japan Canada Brazil Harmonized Activity Joint Activity Other organization

Functional Area	Pre-2010	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018+
			COSIM002 - Information Management Global Air Traffic Management (ATM) Concept Interoperability Coordination Plan COSIM003 - System Wide Information Management (SWIM) Global Air Traffic Management (ATM) Concept Interoperability Coordination Plan COENV002 - Atlantic Interoperability Initiative to Reduce Emissions (AIRE) Coordination Plan COCNS063 - Global Navigation Satellite Systems (GNSS) Applications Coordination Plan COTBO006 - Performance Based Navigation (PBN) Coordination Plan COTBO007 - Common Trajectory Definition and Exchange for Global Air Traffic Management (ATM) Concept Coordination Plan COWX002 - Meteorological Information Exchange for Global Air Traffic Management (ATM) Concept Coordination Plan								

APPENDIX B: ICAO Global Structure Attribute Alignment Comparison

For Appendix b, see additional spreadsheet file named: "30_0025_CDRL_1184_0013_20111007 Final Global Harmonization Roadmap & Summary Report of Methodology (Part 2).xls."